Retrofit Gas Lift

Pilot Installation of Retrofit Gas Lift System

Brae Bravo – UK North Sea

Alun Whittaker – Business Development Manager – Coiled Tubing & Thru-Tubing Services
Agenda

Presentation Outline

• Formalities
• Project Background
• Design Concept
• Retrofit Gas Lift System & Equipment
• Well B-02 Job Execution
• Results from this Project
• Where Do We Go From Here?
• Thank You & Questions
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Project Background

Overview of the Brae Area
Project Background

North Brae Reservoir

- Aquifer has been sweeping from east to west as the reservoir pressure has declined
  - Water encroachment within good quality rock causes the sequential loading of wells

- Reservoir simulation studies and technical experience suggest stranded mobile gas exists around currently shut-in producers

- Aquifer in-flux, however, has resulted in liquid loading

- Retrofit Gas Lift (RGL) concept was born from pursuit of lifting water and allowing mobile gas to produce

B-02
Project Background

- RGL system co-developed between Weatherford and Marathon in 2009.
- 5-1/2” Pilot system deployed in the Well B-02 - Spring 2010.
- 4 more systems installed since.
  - Brae B
    - 4-1/2” & 5-1/2”
  - East Brae
    - 5-1/2” & 7”
Project Background

Conventional Gas Lift

- B02 RGL differs from conventional gas lift (G/L) in two obvious areas:
  - 1) Gas Lift Gas Wells
     - Typically G/L is applied to oil wells to lighten the density of the liquid phase
     - Gas lifting gas wells is less common since gas is much lighter and will generally flow naturally
  - 2) G/L Below Production Packer
     - Typically G/L is achieved through side-pocket mandrels
     - G/L can usually only be introduced no deeper than the production packer
RGL Design Concept

*Deep Gas Lift Solution*

- Use Marathon-designed AVE (Annular Velocity Enhancer) to take gas lift to the perforations
  - Standard gas lift only goes as deep as the packer
    - On Brae B wells this can be over 2,000 feet away from the perforations
  - Getting gas lift as deep as possible allows the well to produce more water

- Deployment issues
  - Depth control to align straddle across tubing punch
  - Engaging upper and lower seal assemblies
RGL Design Concept

Liquid level balances reservoir pressure – gas well will not flow naturally

RGL system permits the introduction of gas lift below the production packer

Deep gas lift entry improves the hydraulic efficiency, enabling the lifting of water, and mobile gas production can commence
## Specifications

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Weatherford WidePak™ Packer
ISO 14310 V0 Certified
RGL System & Equipment

Lower - WidePak™ Packer

Slotted Joint

PBR (Polished Bore Receptacle)

800 ft – 2” x 16Cr Coiled Tubing

Dual Flapper Check Valves c/w Pump Out Sub

Bull Nose
RGL System & Equipment

Upper - WidePak™ Packer

Marathon AVE (Annular Velocity Enhancer)

RS Anchor

Connector Tube

Seal Assembly
B02 RGL Deployment

*Onshore Trials*

- Onshore planning involved 6 different companies and 20+ personnel
- Onshore trials conducted to test equipment
RGL Deployment in Well B-02

Outline Procedure

- Perform Drift Runs with Slick-line
- Punch Tubing using Electric Line
- Run Coiled Tubing Tail and set Packer using Coiled Tubing
  - Run 800ft of 16Cr Coiled Tubing & Hang Off
  - Change to Work Reel (standard coiled tubing)
  - Run in and set Packer using Hydraulic Setting Tool
- Run Upper Packer and AVE Assembly using 5/16” Braided Wireline and Hydrostatic Setting Tool
B02 RGL Deployment

*Job Execution – Step 1: Wellbore Prep*

- Around 40 offshore personnel involved in running the system
- Pre-job safety meetings held with all personnel from all companies numerous times throughout the job
  - Discuss the current operation, any associated risks, and reinforce the reporting structure and Marathon safety
- The wellhead seals were previously tested for integrity
  - The tubing and annuli were also pressure tested.
- Rig up slick line and carry out a series of drift runs to ensure tubing was clear for the straddle assembly to be run
- E-line was used to punch the 5 ½” tubing and re-perforate the well
RGL Deployment in Well B-02

B02 RGL Deployment
*Job Execution – Step 2: Run Lower Straddle*

- Rig up coiled tubing and set a lower straddle assembly
  - This included 800ft of 2” chrome coil tubing
5/16” braided line was then used to set the upper assembly.
RGL Deployment in Well B-02

Rationale Behind Using 5/16” Braided Line to Run Upper Packer

• Due to the high friction when stabbing in both seal assemblies.

• Ability to stab in to the upper packer and then “tap” down using the 2 9/16” mechanical (spang) jars to ensure that both seals were engaged and that the RS Anchor was latched.

• Ability to take 1500# overpull to confirm that assembly was fully engaged.

• Hydrostatic setting tool was used for this application.
RGL Deployment in Well B-02

B02 RGL Deployment

Job Complexity

- The complexity of the operation cannot be overstated
  - Strict attention to ensuring zero safety or environmental incidents

- At several stages in the deployment, we were required to come up with some rather novel solutions

- For example, when joining the chrome coil to the lower assembly:
  - Had to run pump-open plug and two flapper valves on bottom of coil to prevent gas release
  - Hung off coil in BOPs prior to cutting
  - Special slips made for end connector to join coil with the lower assembly
RGL System

Installation

- Lower Packer
- Ported pup
- Seal assembly
- Coil connector/ x-over
- +/- 800 ft Coil string
RGL System

Installation

A

B

C

Upper Packer

AVE

Tubing Punch

Latch

Lower Packer

Ported pup

Seal assembly

Coil connector/ x-over

+/- 800 ft 16%Cr Coil tubing
Injection gas enters the tubing via the punched holes and is directed down through the string via the AVE through the Connector Tube to the Insert string.

Hydrocarbon returns are then taken back to surface via the ported sub, through the lower Straddle, through the AVE and then through the Upper Straddle bore to surface.
Link to animation

2012-528_Wftd_RGL_wip_v1_8.wmv%
RGL Deployment in Well B-02

**B02 RGL Deployment**

*Execution Summary*

- Physical deployment of the down-hole equipment was a huge success
- Total project took approximately 17 days to execute
- Several lessons learned have been documented for future jobs
- Over 6,000 offshore man-hrs worked with no incidents, accidents or environmental spills
Results From This Project

B-02: Summary – Project Delivery

• B-02 had not produced in 2.5 years now produces over 5 MMSCFD
  • Very short payback time

• RGL Deployment was first of its kind offshore for MOC and in the North sea

• A fantastic example of teamwork and innovation contributing more to the Brae well intervention value-addition story
Retrofit Gas Lift in the Brae Field

Where Do We Go From Here?

- Potential exists for the RGL technology to be further deployed on both Brae Bravo and East Brae platforms.

- Challenges exist on both platforms that add to the timescale required to implement:
  - Revision to Safety Case required, with an associated 3 month government review period.
  - Brae B is at the current water handling limit of the platform.
  - East Brae requires a gas lift manifold.
  - Existing wellbores all pose unique challenges; every implementation will be bespoke.

- Work has commenced to address all of these:
  - “Stretch” goal in place to have a retrofit gas lift solution on East Brae by the end of Q1 2011.
Progress Since the Pilot Installation

- Second 5-1/2” Installation successfully completed in Q1 2011 and producing in excess of 4 MMSCFD.

- Installation of Pilot 4½” system in Q2-2011 – Brought online in May 2012 at over 5 MMSCFD.

- East Brae
  - Installation of Pilot 7” system in Q3-2011
  - Third 5-1/2” system installed Q4-2011

- 6 North Sea wells planned for 2013
  - Hybrid 5-1/2” x 7” system.

- 4 well project in Alaska – First 2 installed 2012
  - Alternative deployment concept

- 8 well project in planning/design phase for Indonesia
  - New 3-1/2” system
Alaska Deployment Changes

• Some wells are straddling existing GLM’s

• Flowing Surface Temp – 47°F
  – Strict attention to pressure drop through the system and associated cooling effect.

• Injection string is jointed pipe – up to 3200ft.

• Integral GLM’s in the injection string to assist unloading

• Lower packer system deployed via HD E-line

• Upper packer system deployed via Slickline
Conclusions

• Retrofit Gas Lift is a viable Thru-Tubing Intervention option that can be installed in most wells regardless of completion design.

• RGL is a suitable alternative to breath life into old oil & gas wells suffering from production decline or water influx.
Thanks & Questions

Marathon OGC UK
Frank Rattray

You – The Audience